

# NASA-USRP Summer 2013 Internship Final Report

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## Nomenclature

$P$	= Pressure, psi
$t$	= Minimum wall thickness, in
$S$	= Allowable stress for material, psi
$E$	= Quality factor
$W$	= Weld joint strength reduction factor
$Y$	= Coefficient
$D$	= Minimum outer diameter, in
$\tau$	= Shear stress, psi
$F$	= Force exerted on the cross-section
$A$	= Internal or external thread area

## I. Abstract

Three major projects were undertaken during the Summer 2013 USRP Internship: (A) assisting the cTAPS group with component and pressure vessel system analyses and documentation, (B) designing a hoisting fixture for a solid rocket motor, (C) finding an alternative to removing the DOT rated gaseous nitrogen tank from the roof for hydrostatic testing. Hypergolic Material Assessments (HMAs) and pressure calculations were performed on components of pressure systems. Additionally, component information was logged in the Standard Parts Database to provide a location where system designers can find information regarding components, including their specifications and compatibility with fluids. A hoisting fixture was designed to hoist a solid rocket motor and meets the specifications related to stress and size. However, there are issues with the fixtures bolt head allotment, the bolt spacing, and the complexity of the part. Finally, calculations were performed on an expiring DOT rated gaseous nitrogen tank in an attempt to re-rate it per ASME standards. This was unsuccessful so other options are being explored for the tank. While much progress was made on all three projects, there is still work to be performed on each project to achieve the desired results.

## II. Introduction

### A. Core Team Approach to Pressure Systems

The Core Team Approach to Pressure Systems (cTAPS) group at White Sands Test Facility (WSTF) is tasked with performing analyses on mechanical components, such as ball valves and pressure regulators, within pressure vessel systems to ensure that those components are compatible with the hypergolic fluid, pressure, and temperature in which they are used.

#### 1. Component Analyses

The media compatibility for a particular component is determined through Hypergolic Material Assessments (HMAs). The hypergolic fluids typically used at WSTF include hydrazine, monomethylhydrazine, and nitrogen tetroxide. An HMA lists the various pieces of a component, the material that the pieces of the component are made of, and the compatibility of the materials with a particular hypergolic fluid. Determining whether or not a piece of a component will be approved for use with a hypergolic fluid is reliant on two factors: (1) the reactivity of the material that the piece of the component is constructed from and (2) the location of that piece within the component. The reactivity of the material with the hypergolic fluid is determined through tests performed by the Standard Test group at WSTF. In these tests materials soaked in hypergolic fluids, then a determination is made as to whether the hypergolic fluid has compromised the material's integrity or whether the material has compromised the fluids integrity. Next, the location of the piece of the component is established in order to determine if the piece is wetted. If the piece is non-wetted, it does not come in contact with the hypergolic fluid and does not pose a serious threat to

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the component regardless of the material it is made from. An example of a non-wetted piece of component is the handle of a pressure regulator; this does not come in contact with the system's fluid. However if the piece of the component is wetted, special attention must be paid to the reactivity of the material from which the piece of the component is constructed.

A component can receive one of four ratings: not approved, approved, conditionally approved, or safety alert. When a piece of a component is both reactive and wetted, the entire component will receive a rating of “not approved.” When a component does not contain any reactive materials in wetted areas, the component will receive a rating of “approved.” However, if the component is originally “not approved” but can be altered in order to make it compatible with the hypergolic fluid, it will receive a rating of “approved.” When a component has a B-rated material that is only exposed to vapor or experiences limited service, the component will be “conditionally approved.” Finally, when the component reacts volatily with a hypergolic fluid and a serious hazard is present, the component will receive a rating of “safety alert.”

If a component is deemed “not approved” for use with a hypergolic fluid and it is considered a highly valuable component, cTAPS looks for solutions that can be implemented to obtain a “conditionally approved” or “approved” rating. This rating can be achieved through a variety of methods. One way to get a component approved is to work with the manufacturer and have them replace the incompatible materials in the component with compatible materials. If the manufacturer is unwilling to alter the component, WSTF may choose to order compatible material from another vendor and fabricate replacement sub-components.

The next step to fully defining a component's usage capabilities is determining its maximum allowable working pressure. Pressure containing areas are analyzed to find the maximum allowable working pressure (MAWP) based on ASME Code B31.3 Section 304:

$$P = \frac{2tSEW}{-2tY + D} \quad (1)$$

Additionally within the pressure calculation, analyses are done on the threads of pressure bearing areas to ensure that thread shear will not occur. For the shear calculation, the first step is calculating the shear area of the internal and external threads. The shear stress on the internal and external threads is calculated by dividing the force on the threads by the internal or external thread area:

$$\tau = \frac{F}{A} \quad (2)$$

The calculated shear stress is then compared to the allowable shear stress. If the calculated shear stress is less than the allowable, then the component passes the shear stress analysis.

Finally, a temperature range is established for the component. This is generally determined based on manufacturer ratings. Most components are rated up to a temperature of 160°F per NASA STD 6001 Test 15 protocol.

## 2. Standard Parts Database

The Standard Parts Database (SPD) is a database that contains a list of components used in pressure systems and details on these components. Table 1 shows the data fields found in the database; the data fields are sorted into general component information and media specific information. The purpose of the SPD is to allow system designers to more efficiently identify components that can be used in a pressure vessel system that they are designing.

**Table 1: Standard Parts Database Content.**

Standard Parts Database	General Component Information		Media Specific Information	
	Component Type		Rating	
	Manufacturer		Supporting Approvals	
	Model Number		Diagram	
	Estimated Cost		Rating Comments	
	Comments		MAWP	
	Documents		Temperature Range	
	Inlet Size/Connection		Soft Goods	
	Outlet Size/Connection		Metals	
	Code Justification		Warehouse Number	
			Soft Goods Kit	

## **B. Solid Rocket Motor**

A test is being performed on a solid rocket motor to determine the fragmentation pattern created by dropping the motor and the properties of individual blast fragments. The motor will need to be hoisted to perform the test. The task was to design a hoisting fixture for the solid rocket motor.

The original hoist design created by Arcenio Baca was not approved due to its large size. Using a large ring might create greater fragmentation which would alter the data collected from the drop. Therefore, a smaller hoisting fixture was required for the drop. The combination of hoisting fixtures had to be rated for up to 8000 pounds of force.

## **C. DOT Rated Gaseous Nitrogen Tank**

An accumulator tank located in the penthouse on the roof of building 201 is used to provide additional volume for use in the NBIC certified Valve Repair (VR) shop relief valve test system. The tank was rated DOT 3AA-3000. DOT tanks with this rating require hydrostatic testing every five years and the expiration date was August 23<sup>rd</sup>, 2013. To get the DOT tank hydrostatic testing, it would have to have been removed from the roof. Removal of the tank was estimated to cost \$20,000. Other options were explored for the tank in an attempt to identify a cheaper, long term solution.

# **III. Description of Activities**

Over the past ten weeks, I have been focusing on three major projects: (A) assisting the cTAPS group with component and pressure vessel system analyses and documentation, (B) designing a hoisting fixture for a solid rocket motor, (C) finding an alternative to removing the DOT rated gaseous nitrogen tank from the roof for hydrostatic testing.

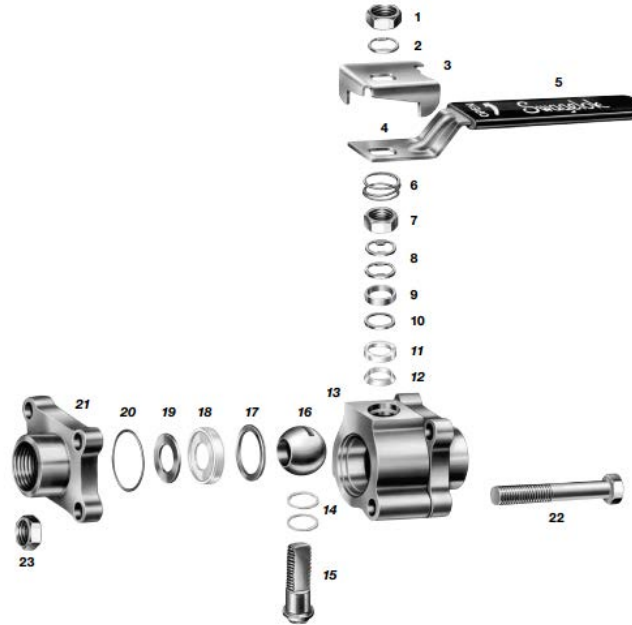
## **A. Core Team Approach to Pressure Systems**

### *1. Component Analyses*

There are two components that I have worked on extensively: the Swagelok 60 series manual valve and the TESCO 26-2300 Back Pressure Regulator.

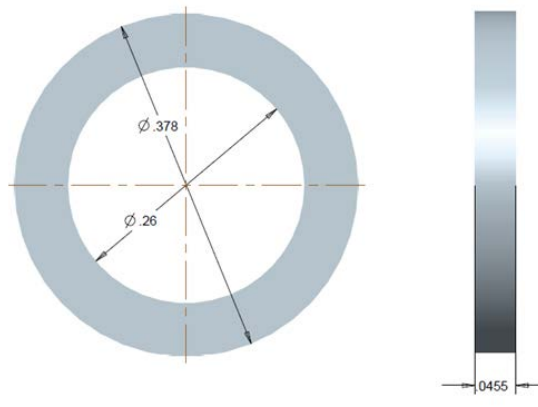
- **Swagelok 60 Series Manual Valve**

The original hypergolic material assessments that were performed on the Swagelok 60 series manual valve (see Figure 1 for diagram) were “conditionally approved” for the hypergolic fluids. However, the HMAs for each of the three hypergolic fluids recommended different solutions to make the component compatible. The goal of the cTAPS group was to modify this component so that there was one kit that made it compatible with all hypergolic fluids. To make a single component configuration that was compatible with the three hypergolic fluids, the stem bearings (piece number 14 in Figure 1), the packing supports (piece number 10 in Figure 1), and the flange seals (piece number 20 in Figure 1) were replaced. The packing support was originally ordered in either PEEK (for MMH and hydrazine) or Halar 300 (for oxidizer). The stem bearings were ordered in Inconel X-750. Inconel X-750 is compatible with all hypergolic fluids but requires a lubricant. There are no compatible lubricants available, therefore another alternative needed to be identified. The flange seals were originally ordered in PTFE, however the manufacturer indicated that PTFE should not be used at temperatures below 50°F. During winters, temperatures go below this point causing the PTFE to shrink resulting in leakage.



**Figure 1: Diagram of 60 Series Swagelok Valve<sup>1</sup>.**

The stem bearings and packing supports were modeled in Creo ProE (see Figure 2) for ¼", ½", and 1" valves. The drawings were sent to the machine shop at WSTF and the stem bearings and packing supports were machined out of stainless steel filled PTFE. Stainless steel filled PTFE is expected to be A-rated for monomethylhydrazine and B-rated for oxidizer and hydrazine. However, the results are still awaiting final analysis. If it passes, then the stem bearings and packing supports will be replaced with stainless steel filled PTFE because stainless steel filled PTFE is functional at lower temperatures than plain PTFE.



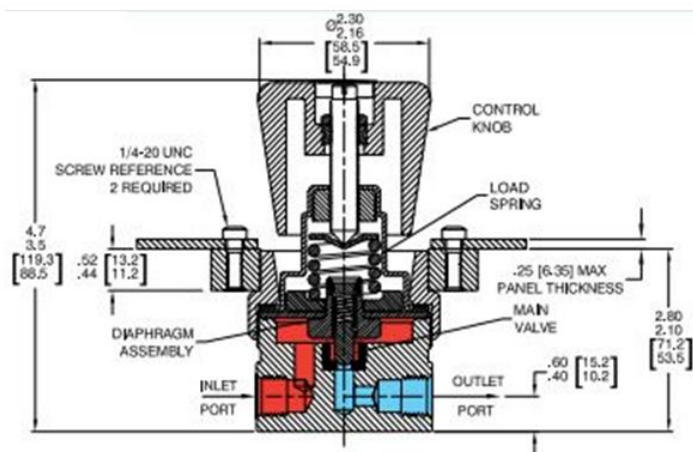
**Figure 2: Creo ProE Drawing of Stem Bearing and Packing Support for ¼" Swagelok 60 Series Valve.**

Similarly, the flange seals were replaced with PTFE coated Alloy X-750. The flange seal was ordered from El Paso Fluid System Technologies, Corporation. PTFE coated Alloy X-750 is compatible with all hypergolic fluids.

Finally, the reconfigured valve went through the valve repair shop to ensure that it was functioning properly and could withstand the manufacturer's reported maximum allowable working pressure. The valve passed the functional test and was approved for use in pressure systems.

- TESCO 26-2300 Back Pressure Regulator

Pressure calculations and a hypergolic material assessment were required for a TESCO 26-2300 back pressure regulator (see Figure 3). Extensive communication with TESCO was required to obtain a comprehensive bill of materials and dimensioned drawings.



**Figure 3: Drawing of TESCO 26-2300 Back Pressure Regulator<sup>2</sup>.**

First, a pressure calculation was performed to ensure that TESCO's pressure rating was appropriate. TESCO rated this part for use at 500 psi. The maximum allowable working pressure was calculated using the minimum wall thicknesses for pressure containing areas. Ultimately, it was determined that the TESCO 26-2300 back pressure regulator was acceptable for use at the maximum allowable working pressure of 500 psi.

Next, a hypergolic material assessment was performed to ensure that the back pressure regulator was compatible with hydrazine. TESCO sent a detailed bill of materials which allowed for each piece of the component and its material to be identified. Each material listed on the bill of materials was looked up in the White Sands Test Facility Standard Instruction (WSI) to determine if the materials used to construct the component were compatible with hydrazine. After reviewing all of the material for the wetted components, it was discovered that the spring is made of elgiloy which contains a significant amount of cobalt. Cobalt is highly reactive with hydrazine. Therefore, this part was conditionally approved with the stipulation that the elgiloy spring must be replaced with a stainless steel spring. TESCO was contacted to see if they would be willing to replace the elgiloy spring with a stainless steel spring and they were receptive to the idea.

## 2. Standard Parts Database

The Standard Parts Database has been a work in progress for approximately ten years. Originally it was a Microsoft Access database but this summer a web-based Standard Parts Database was launched. The task was to notify the database group with issues and glitches found in the web-based SPD, provide feedback to the database group about the format and changes that would make the database more user friendly, and ensure that the information in the database was up to date.

There were a variety of technical issues with the database that have been resolved over the course of the summer. These issues include: inability to reset the search page; inability to input inlet and outlet sizes for components; having to enter the supporting approval ID twice for the database to record the number; excessive limitations on file size of diagrams of the parts; inability to delete parts once they had been entered into the database; limited view of digits in temperature range entry boxes.

Additionally, many changes were made to the format and editing capabilities of the database to make it more straightforward and navigable. These changes included: linking the WSTF ID number to the HMA document number; creating drop down menus for the inlet and outlet sizes; creating a "copy component" feature that allows an editor to quickly enter a component similar to a previous component into the database; entering data for individual components as opposed to generically entering the data for multiple components; creating a location to attach HMAs and pressure calculations to the entry.

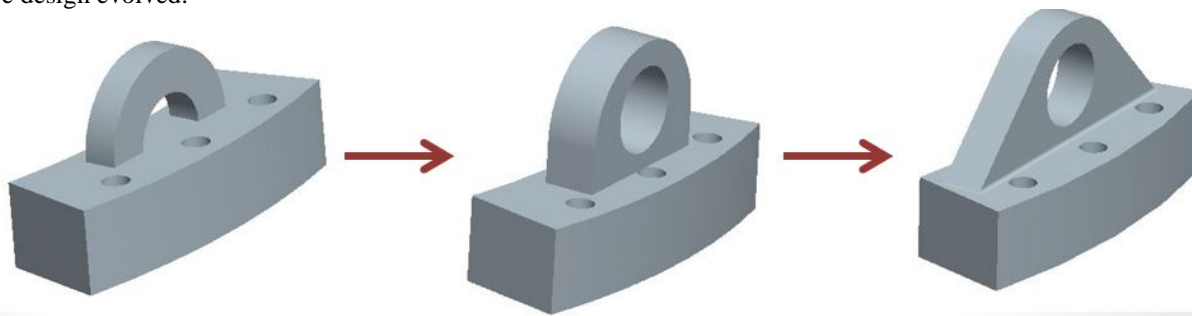
Throughout the summer, information on various components was updated and input into the database. All components with completed, signed hypergolic material assessments were input in the database. Also, some pressure calculations and substantiations were uploaded to the database. Finally, a prioritized list was created that identified the components used at WSTF that still require hypergolic material assessments and pressure calculations. This list will allow for speedy analysis of the most important components used at WSTF.

## B. Solid Rocket Motor Hoisting Fixture

Many options were explored while determining which hoisting fixture would be best for hoisting the solid rocket motor. The combination of hoisting fixtures used to hoist the motor needed to be rated for an 8000 pound load.

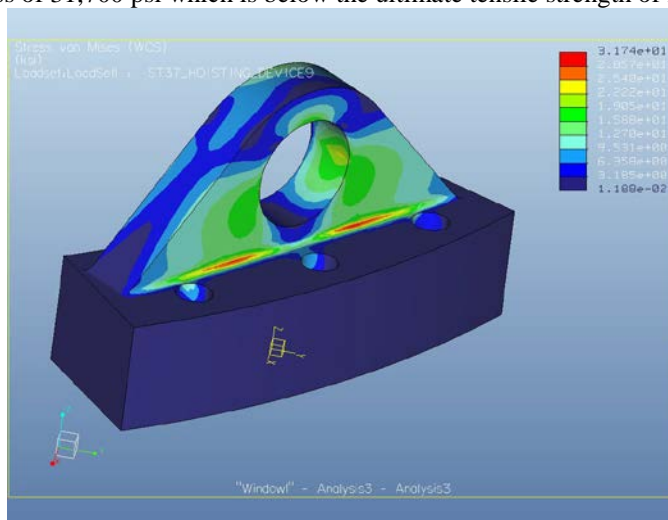
The goal was to design a hoisting fixture such that four of these hoisting fixtures could be evenly spaced around the perimeter of the nozzle flange. This means that each hoisting fixture would need to be able to withstand a 2000 pound load. To test at a worst case scenario, the load was assumed to be applied at a 45 degree angle. The hoisting fixture was modeled as low carbon steel. To determine if the hoisting fixture was capable of withstanding the load, a finite element analysis was performed in Creo Pro/E. To be deemed safe, the hoisting fixture had to have a von Mises stress less than the ultimate tensile stress of low carbon steel (35,000 psi).

While attempting to meet the stress requirements, the design went through an evolution. Figure 4 shows how the fixture design evolved.



**Figure 4: Evolution of the Hoisting Fixture Design.**

The configuration of the part was changed to lessen the maximum stress seen by the part. Figure 5 shows the finite element analysis for the most updated version which meets the stress requirements. The current hoisting fixture has a von Mises stress of 31,700 psi which is below the ultimate tensile strength of low carbon steel.



**Figure 5: Finite Element Analysis for Current Hoisting Fixture.**

### C. DOT Rated Gaseous Nitrogen Tank

Due to the high cost associated with removing the DOT-rated tank from the roof and getting it re-inspected as a DOT tank, other options were explored for the tank. Three other options were identified: 1) re-rate the tank per ASME standards, 2) purchase new ASME-rated tank, or 3) run the system without the tank.

The first option considered was rating the tank per ASME standards. Re-rating the tank per ASME standards would have been advantageous because ASME rated tanks do not require periodic testing and maintain their certification indefinitely. To determine if the tank could be ASME certified, pressure calculations were performed based on the wall thickness and tank material. Information on the tank was not well documented and the manufacturer could not be located so tests were performed by WSTF's metallurgical lab to determine the wall thickness and material type. Calculations were performed per ASME BPVC Section VIII, div 1 - 2010 UG-27c and it was determined that the tank could not be ASME certified. The circumferential stress and longitudinal stress were calculated and the lower of the two was considered to be the maximum allowable working pressure. This value was 2,195 psi which is below the required 3,000 psi. Therefore, this tank could not be recertified per ASME standards.

Next, purchase of a new tank was considered. To determine if this was a viable option, a quote was obtained from the company Prentex to find the price of a new tank. Prentex was contacted and the requirements were

outlined: ASME rated, stainless steel tank with a volume of 11 cubic feet and a pressure rating of 3000psi with one 2 inch diameter inlet and one two inch diameter outlet; capable of withstanding temperatures between -20°F and 200°F with legs as supports. Prentex returned a quote of approximately \$20,000.

The final option was for the valve repair shop to attempt to function without the tank. There was concern that bypassing the tank would create issues with data produced during valve testing and negatively impact the gaseous nitrogen storage area. Testing was being performed to determine if bypassing the tank is a viable option.

#### **IV. Results**

With regards to the Core Team Approach to Pressure Vessel Systems' projects, progress was made on finding solutions to compatibility issues and in documenting components. Two highly useful parts, the Swagelok 60 series manual ball valve and the TESCO 26-2300 series back pressure regulator, were not originally compatible with hypergolic fluids. Alterations were made to the Swagelok 60 series manual ball valve so that it is now compatible with all hypergols. Modifications to the TESCO 26-2300 series back pressure regulator were identified so that it can be altered to be compatible with hydrazine. Additionally, the Standard Parts Database (SPD) was tested and issues were resolved. Now, the database is live and fully functional and contains all currently signed HMAs. Also, a prioritized list of HMA and pressure calculations that require work were identified.

A hoisting fixture was designed for the solid rocket motor. While the hoisting fixture meets the load requirements, it is not at a functional status. Room required for the bolt heads was not accounted for. Additionally, the hoisting fixture was modeled based on inaccurate bolt spacing. Finally, the component is more complex than it needs to be considering its use – edges do not need to be rounded and other complexities can be eliminated to reduce price. Additional modifications to the component are required to get it to the specifications.

For the gaseous nitrogen tank, the options were narrowed down. Since the tank did not meet the required pressure, it could not be re-rated for ASME. Therefore, the first option was ruled out. The second option, purchasing a new tank, is relatively costly. Therefore, testing has been initiated to determine if doing without the tank is an option. Depending on the results of these tests, either the tank will be bypassed or a new tank will be purchased.

#### **V. Conclusion**

Overall, the work performed during the summer 2013 USRP internship was useful to White Sands Test Facility. The Hypergolic Material Assessments and pressure calculations provided information on the conditions under which particular components can be used. This allows for the safe usage of more types of components which is important to the productivity of WSTF. The Standard Parts Database will now allow system designers to more effectively locate parts that are compatible with the systems they are creating. Additionally, the new SPD format makes entering components into the database easier. Despite the fact that the hoisting fixture still requires editing, the basic design can be altered to create a usable fixture. Finally, despite the bad news that the DOT-tank could not be re-rated per ASME standards, other options were identified and the valve shop now has a plan of action.

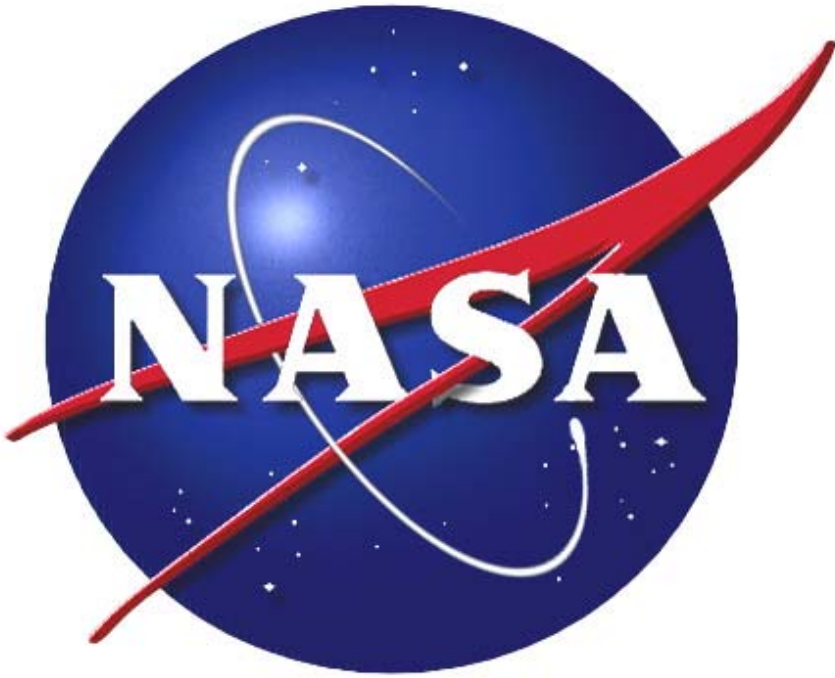
#### **Acknowledgments**

I would like to thank all of the staff at WSTF, especially those in cTAPS. In particular, I would like to thank Miguel Maes, Chris Wojtko, Bruce Havenor, Mary Burke, Nick Buntain, Kathleen Franklin, Arcenio Baca, Christina Pina-Arpin, John Anderson, and Don Gonzalez.

#### **References**

<sup>1</sup>Swagelok., "60 Series Ball Valves," [website], URL: <http://www.swagelok.com/downloads/WebCatalogs/EN/MS-01-146.pdf> [cited 13 August 2013]

<sup>2</sup>TESCOM., "26-2300 Series," [website], URL: [http://www.documentation.emersonprocess.com/groups/public/documents/data\\_sheets/d26230694x012.pdf](http://www.documentation.emersonprocess.com/groups/public/documents/data_sheets/d26230694x012.pdf) [cited 13 August 2013]



# Exit Presentation

Christine Gurganus

NASA USRP Intern

Mentor: Miguel Maes

White Sands Test Facility - Technical Services

Tour Dates: June 10<sup>th</sup> to August 16<sup>th</sup>



# Agenda

- Projects
  - cTAPS
    - Swagelok 60 Series Manual Ball Valve
    - TESCO 26-2300 Series Back Pressure Regulator
    - Standard Parts Database
    - Prioritized list of Hypergol Material Assessments and Pressure Calculations Required
  - Hoisting Fixture for Solid Rocket Motor
  - Rating DOT GN2 Tank for ASME
- Lessons Learned
- The New Mexico Experience
- Future Plans
- Acknowledgements

# cTAPS

Transitions and certifies pressure vessel systems and their components based on requirements outlined by ASME B31.3 code and WSI 09-SW-0024.

- Hypergol Material Assessments (HMAs)
  - Ensure the compatibility of fuels and oxidizer with the components used in pressure systems
- Pressure Calculations
  - Maximum allowable working pressure (MAWP) is calculated for components
  - Calculated pressure is compared to manufacturer's listed pressure
  - Calculated MAWP is supported by a substantiation like FEA
- Standard Parts Database (SPD)
  - Allows user to search for components, their specifications, and their compatibility with fluids

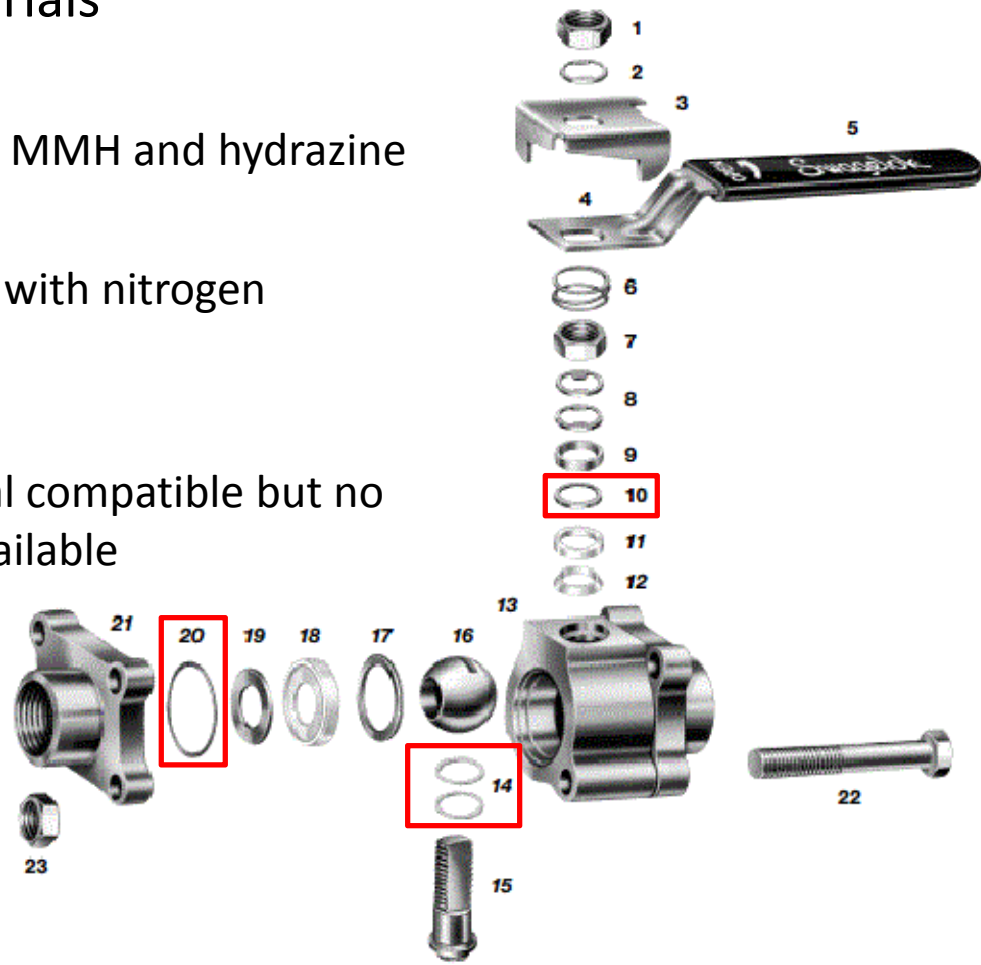
# Swagelok 60 Series Manual Ball Valve

- Goal: Replace incompatible materials with materials that are compatible with all hypergolic fluids



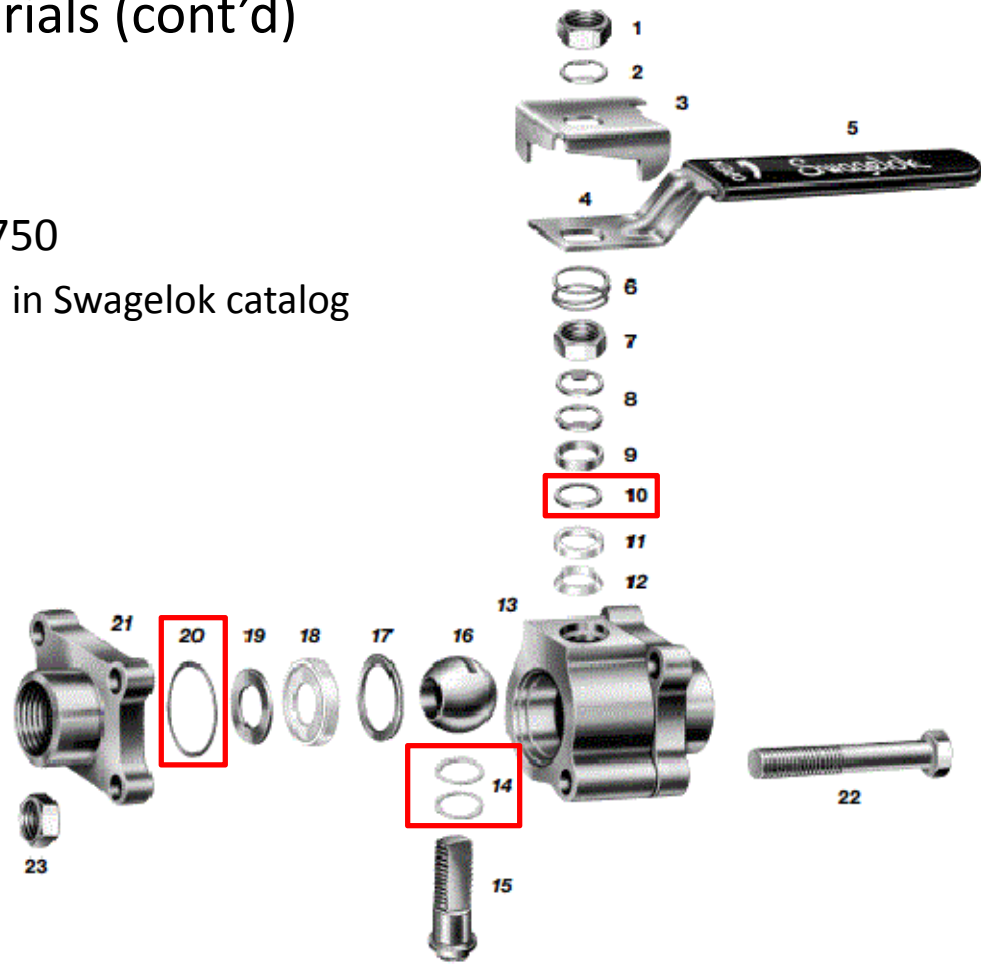
# Swagelok 60 Series Manual Ball Valve

- Issues with Original Materials
  - Packing Support (10)
    - PEEK – compatible with MMH and hydrazine  
OR
    - Halar 300 – compatible with nitrogen tetroxide
  - Stem Bearings (14)
    - Inconel X-750 – material compatible but no acceptable lubricant available



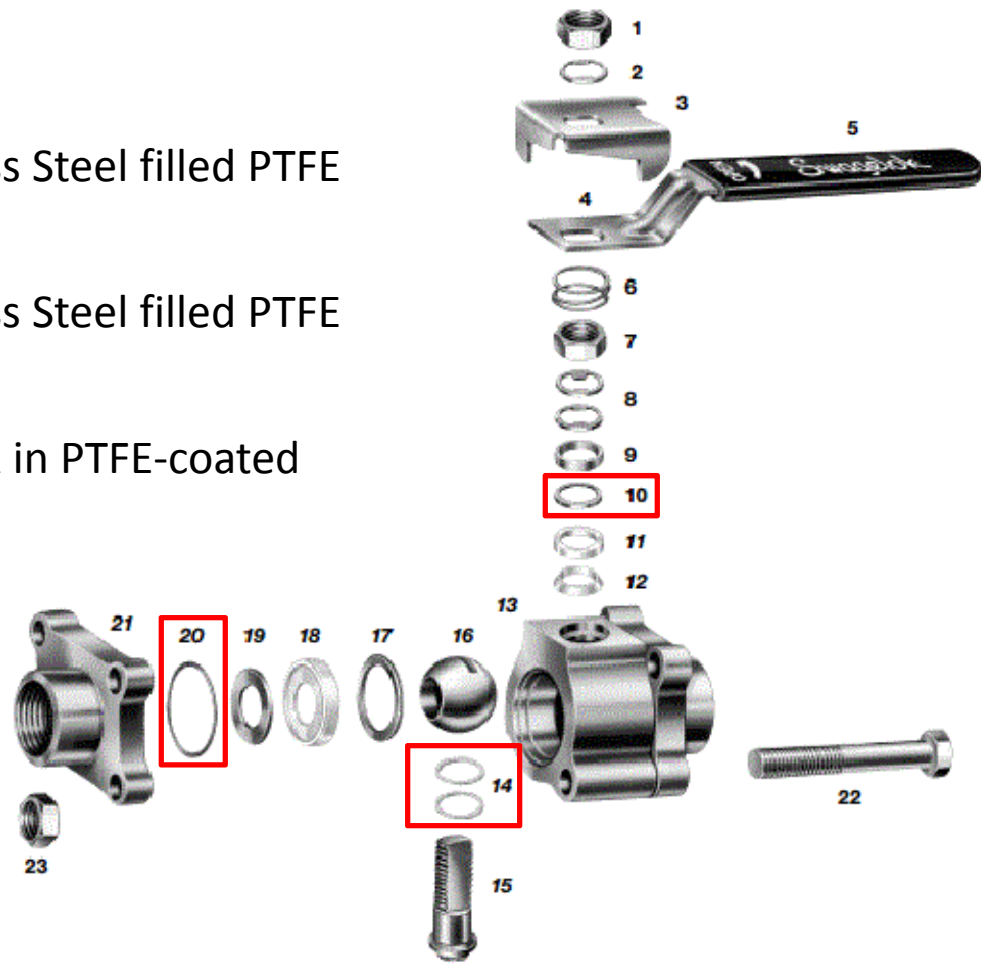
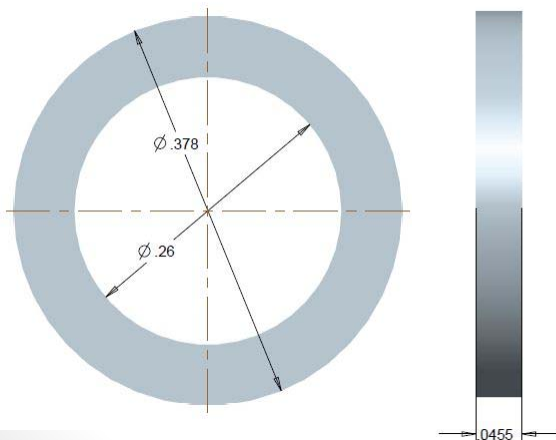
# Swagelok 60 Series Manual Ball Valve

- Issues with Original Materials (cont'd)
  - Flange Seals (20)
    - Fluorocarbon FKM
    - PTFE-coated Inconel X-750
      - Only recently appeared in Swagelok catalog
    - Buna N
    - Buna C
    - Ethylene Propylene
    - Neoprene
    - PTFE
      - Temperature range:  
Shrinks at cooler temperatures causing loss of sealing



# Swagelok 60 Series Manual Ball Valve

- Replacement Materials
  - Packing Supports (10)
    - Machined from Stainless Steel filled PTFE
  - Stem Bearings (14)
    - Machined from Stainless Steel filled PTFE
  - Flange Seals (20)
    - Ordered from Swagelok in PTFE-coated Inconel-750



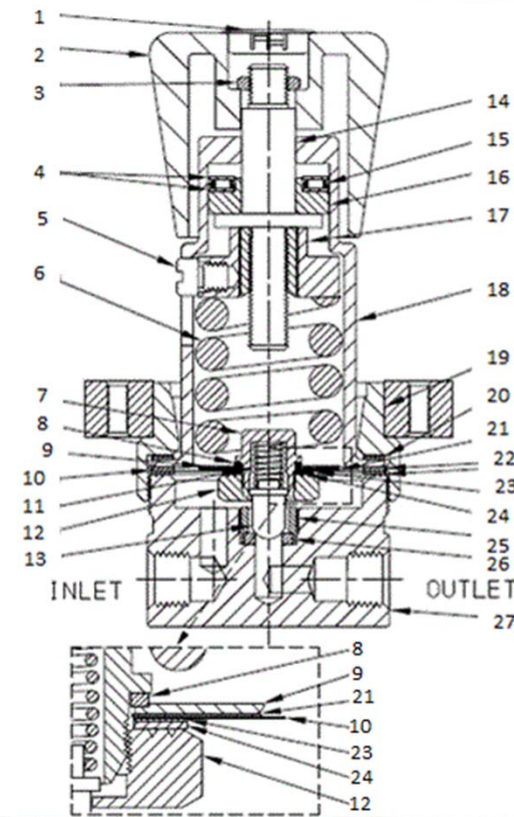
# Swagelok 60 Series Manual Ball Valve

- Passed functional test
- Revised Hypergol Material Assessments for valve
- Waiting for final determination by Hypergol Material Assessment Committee (HMAC) regarding the Stainless Steel filled PTFE
  - From preliminary results, an A-rating for MMH and a B-rating for hydrazine and nitrogen tetroxide is predicted



# TESCOM 26-2300 Series Back Pressure Regulator

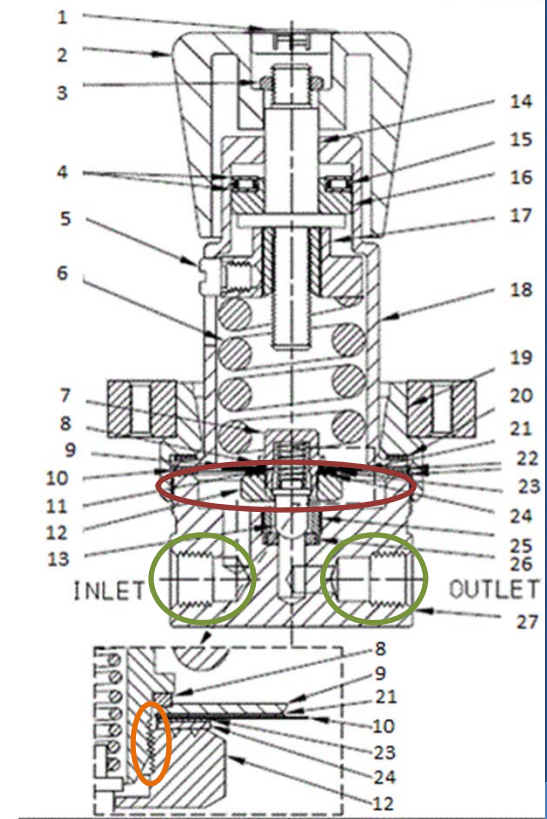
- Goal: Perform hydrazine HMA and pressure calculations on the component
- Needed: Complete bill of materials and dimensioned drawings of pressure containment regions
- Extensive communication with TESCOM to get information regarding component
- Hypergol Material Assessment
  - Determined that original TESCOM part was “Not Approved” because of Elgiloy spring (contains Cobalt which is highly reactive with hydrazine)
  - Negotiated with TESCOM – TESCOM agreed to replace Elgiloy spring with a Stainless Steel spring





# TESCOM 26-2300 Series Back Pressure Regulator

- Pressure Calculations
  - Performed for the **regulator body**, for the **threads on the regulator body**, and for the **inlet and outlet ports**.
  - Found that all locations met the manufacturer's maximum allowable working pressure, 500 psi



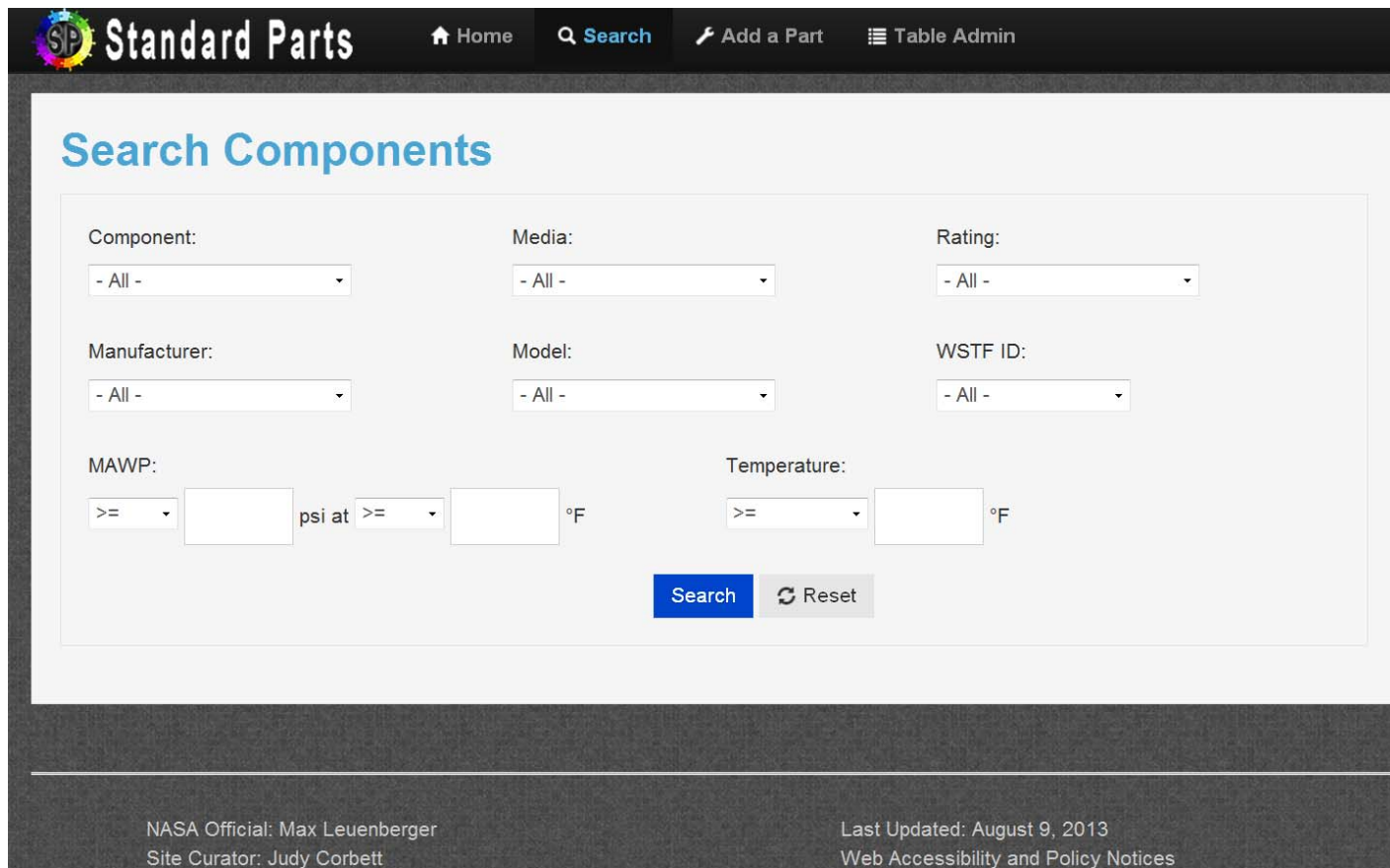
# Standard Parts Database (SPD)

- Purpose: to allow system engineers to more efficiently identify components that can be used in a pressure vessel system that they are designing
- <https://spdb.wstf.nasa.gov/search.cfm>
- Troubleshooting:
  - Technical issues found on “staging” site
  - Improvements to make the database more user friendly (ie – ability to attach HMAs and pressure calculations for a particular component, ability to duplicate a component entry for editing purposes)
- Worked with Database Consultant Group to fix issues and make changes to the SPD
- Output:
  - Fully functioning live database
  - All HMA-approved HMAs have been input



# Standard Parts Database (SPD)

- Search function



The screenshot displays the 'Standard Parts' website interface. At the top is a navigation bar with a logo and links for 'Home', 'Search', 'Add a Part', and 'Table Admin'. The main content area is titled 'Search Components' and contains a search form. The form includes six dropdown menus for 'Component', 'Media', 'Rating', 'Manufacturer', 'Model', and 'WSTF ID', each with '- All -' as the selected option. Below these are two input sections for 'MAWP' and 'Temperature'. Each section has a dropdown for a comparison operator (currently set to '>=') and a text box for a numerical value, followed by the unit 'psi at' for MAWP and '°F' for Temperature. At the bottom of the form are 'Search' and 'Reset' buttons. The footer contains contact information for NASA Official Max Leuenberger and Site Curator Judy Corbett, along with the last update date of August 9, 2013, and a link to Web Accessibility and Policy Notices.

Standard Parts

Home Search Add a Part Table Admin

## Search Components

Component:

Media:

Rating:

Manufacturer:

Model:

WSTF ID:

MAWP:   psi at   °F

Temperature:   °F

Search Reset

NASA Official: Max Leuenberger  
Site Curator: Judy Corbett

Last Updated: August 9, 2013  
Web Accessibility and Policy Notices

# Standard Parts Database (SPD)

- Searching for a check valve that is compatible with MMH

The screenshot shows the Standard Parts Database (SPD) search interface. The header includes the SPD logo, the text "Standard Parts", and navigation links: Home, Search, Add a Part, and Table Admin. The main section is titled "Search Components" and contains a search form with the following fields:

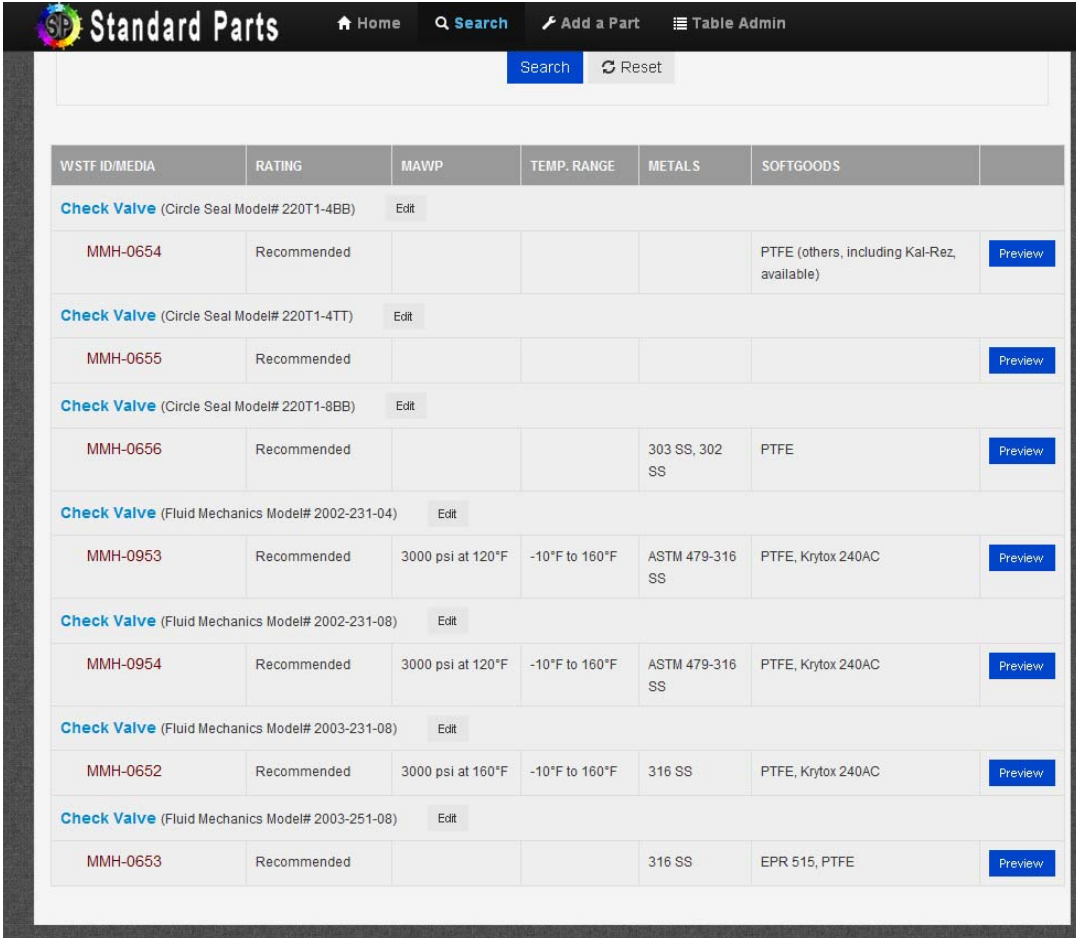
- Component: Check Valve
- Media: MMH
- Rating: Recommended
- Manufacturer: - All -
- Model: - All -
- WSTF ID: - All -
- MAWP: >= [ ] psi at >= [ ] °F
- Temperature: >= [ ] °F

At the bottom of the search form are "Search" and "Reset" buttons. The footer of the page contains the following information:

- NASA Official: Max Leuenberger
- Site Curator: Judy Corbett
- Last Updated: August 9, 2013
- Web Accessibility and Policy Notices

# Standard Parts Database (SPD)

- Results for MMH-compatible check valve



The screenshot displays the Standard Parts Database (SPD) web application. At the top, there is a navigation bar with a logo, the title 'Standard Parts', and links for 'Home', 'Search', 'Add a Part', and 'Table Admin'. Below the navigation bar is a search input field with a 'Search' button and a 'Reset' button. The main content area shows a table of search results for 'Check Valve' parts. The table has columns for 'WSTF ID/MEDIA', 'RATING', 'MAWP', 'TEMP. RANGE', 'METALS', 'SOFTGOODS', and an 'Edit' button. The results are grouped by part type and model number.

WSTF ID/MEDIA	RATING	MAWP	TEMP. RANGE	METALS	SOFTGOODS	
<b>Check Valve</b> (Circle Seal Model# 220T1-4BB) <a href="#">Edit</a>						
MMH-0654	Recommended				PTFE (others, including Kal-Rez, available)	<a href="#">Preview</a>
<b>Check Valve</b> (Circle Seal Model# 220T1-4TT) <a href="#">Edit</a>						
MMH-0655	Recommended					<a href="#">Preview</a>
<b>Check Valve</b> (Circle Seal Model# 220T1-8BB) <a href="#">Edit</a>						
MMH-0656	Recommended			303 SS, 302 SS	PTFE	<a href="#">Preview</a>
<b>Check Valve</b> (Fluid Mechanics Model# 2002-231-04) <a href="#">Edit</a>						
MMH-0953	Recommended	3000 psi at 120°F	-10°F to 160°F	ASTM 479-316 SS	PTFE, Krytox 240AC	<a href="#">Preview</a>
<b>Check Valve</b> (Fluid Mechanics Model# 2002-231-08) <a href="#">Edit</a>						
MMH-0954	Recommended	3000 psi at 120°F	-10°F to 160°F	ASTM 479-316 SS	PTFE, Krytox 240AC	<a href="#">Preview</a>
<b>Check Valve</b> (Fluid Mechanics Model# 2003-231-08) <a href="#">Edit</a>						
MMH-0652	Recommended	3000 psi at 160°F	-10°F to 160°F	316 SS	PTFE, Krytox 240AC	<a href="#">Preview</a>
<b>Check Valve</b> (Fluid Mechanics Model# 2003-251-08) <a href="#">Edit</a>						
MMH-0653	Recommended			316 SS	EPR 515, PTFE	<a href="#">Preview</a>

# Standard Parts Database (SPD)

- Previewing part information

**Standard Parts** Home Search Add a Part Table Admin

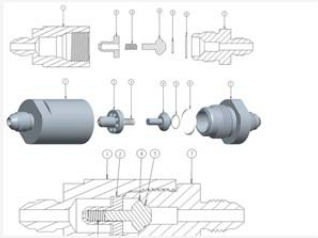
WSTF ID/MEDIA	RATING	MAWP	TEMP. RANGE	METALS	SOFTGOODS	
<b>Check Valve</b> (Circle Seal Model# 220T1-4BB) Edit						
MMH-0654	Recommended				PTFE (others, including Kal-Rez, available)	Preview
<b>Check Valve</b> (Circle Seal Model# 220T1-4TT) Edit						
MMH-0655	Recommended					Preview
<b>Check Valve</b> (Circle Seal Model# 220T1-8BB) Edit						
MMH-0656	Recommended			303 SS, 302 SS	PTFE	Preview
<b>Check Valve</b> (Fluid Mechanics Model# 220P-221-2A) Edit						
						Preview
						Preview
						Preview
						Preview

### Media

**WSTF ID:** MMH-0652  
**Rating:** Recommended  
**MAWP:** 3000 psi at 160°F  
**Temperature:** -10°F to 160°F  
**Metals:** 316 SS  
**Soft Goods:** PTFE, Krytox 240AC  
**WSTF ID:** MMH-0652

### Specifications

**Inlet Size:** 1/2  
**Outlet Size:** 1/2  
**Inlet Connection:** SAE AS4395-08 (1/2" male AN)  
**Outlet Connection:** SAE AS4395-08 (1/2" male AN)  
**Orifice:** .387




### Code Justification

**Code Justification:** Unlisted  
**Calculation Number:** 2727  
**Substantiation Type:** FEA  
**Substantiation Document:** 2728

NASA Official: Max Leuenberger  
Site Curator: Judy Corbett

Last Updated: August 9, 2013  
Web Accessibility and Policy Notices

# Standard Parts Database (SPD)

 **Standard Parts**

HomeSearchAdd a PartTable Admin

## Check Valve Detail

Blit

<b>Manufacturer</b> Fluid Mechanics	<b>Model</b> 2003-231-08	<b>WSTF ID</b> <b>MMH-0652</b>
<b>Documents</b>		<b>Comments</b>
Hydrazine Assessment <a href="#">Hydrazine Assessment</a> MMH Assessment <a href="#">MMH Assessment</a> Pressure Calculations <a href="#">Pressure Calculations</a> Substantiation <a href="#">Substantiation</a>		SCG 8/5/2013

Hydrazine-0652

Hydrogen-0652

Inert-0652

**MMH-0652**

Oxidizer-0652

Oxygen-0652

**Rating:** Recommended

**MAWP:** 3000 psi at 180°F

**Temperature:** -10°F to 180°F

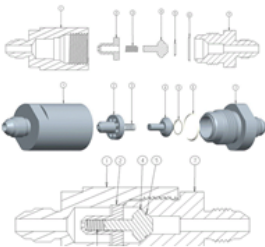
**Metals:** 316 SS

**Soft Goods:** PTFE, Krytox 240AC

**Soft Goods Kit:**

**WSTF ID:** MMH-0652

Quantity:  [Add to Cart](#)



[View full size](#)

<b>Specifications</b>	<b>Code Justification</b>
Inlet Size: 1/2	Code Justification: Unlisted
Inlet Connection: SAE AS4395-08 (1/2" male AN)	Justification Document:
Orifice: .387	Calculation Number: 2727
	Substantiation Type: FEA
	Substantiation Document: 2728



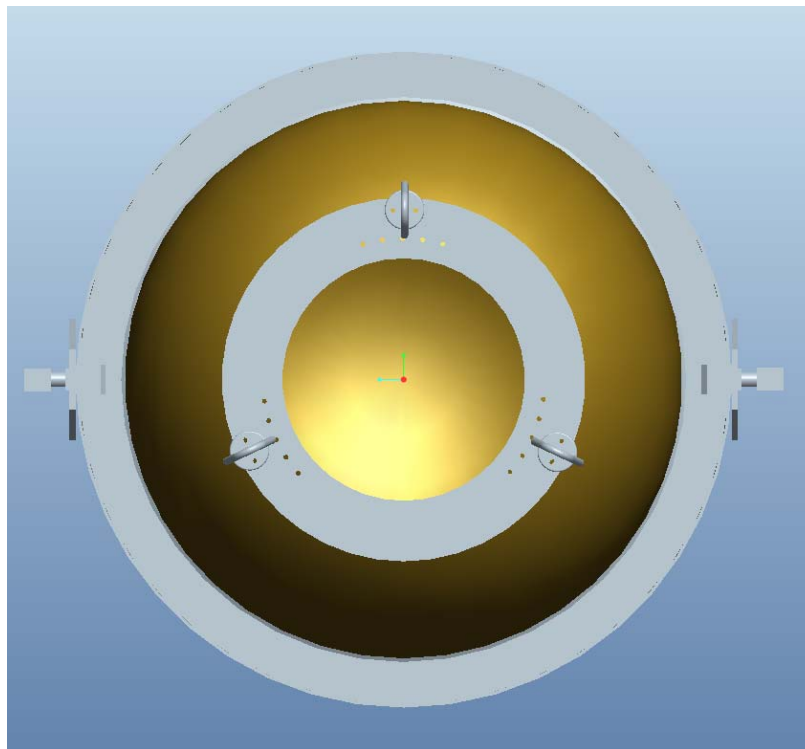
# Prioritized List of HMAs and Pressure Calculations Required

- Purpose: List will facilitate quick identification of HMA and pressure calculation work that is required
- Met with members of cTAPS to identify top priority components (components that are used very frequently and require full pedigree)
- Lists created for 131 components in the old SPD



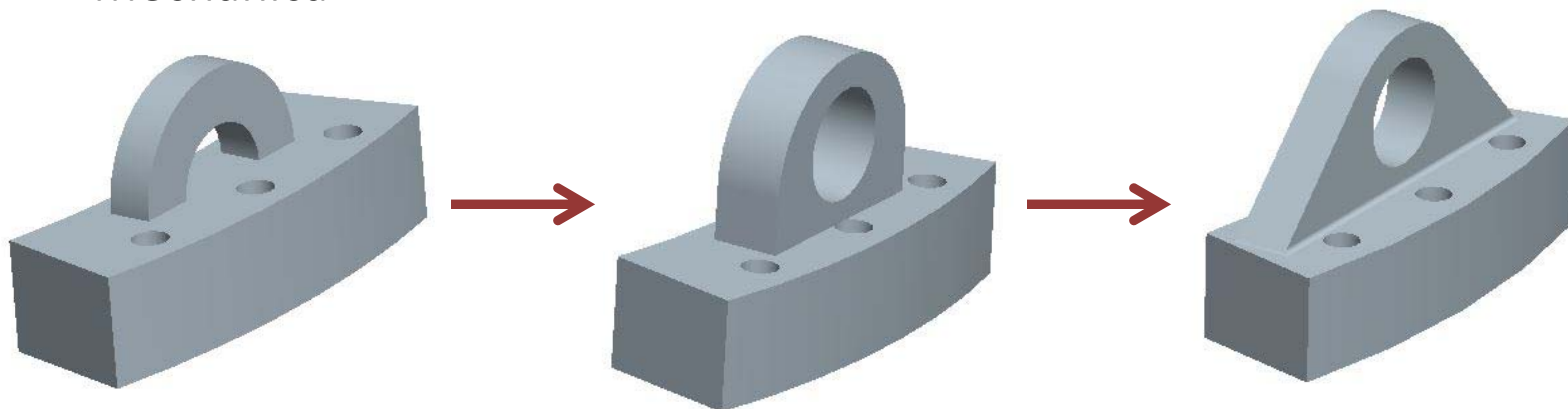
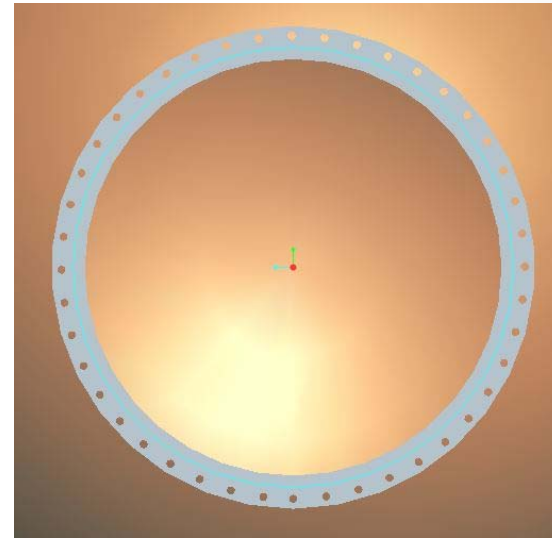
# Hoisting Fixture for Solid Rocket Motor

- Goal: Design a hoisting fixture for a solid rocket motor with minimal fragmentation implications that can be subjected to an 8000 pound load
- Original design had potential to effect data due to size:



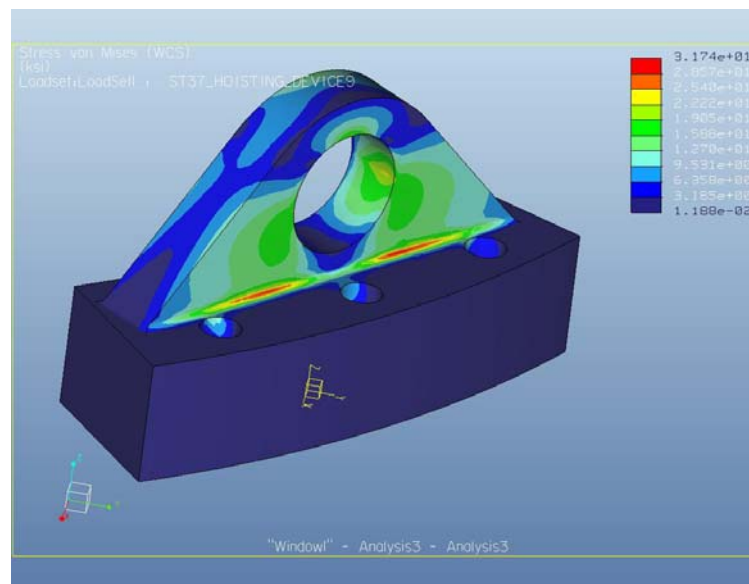
# Hoisting Fixture for Solid Rocket Motor

- Four spaced around the nozzle flange of the motor
- Design evolved into a part that was capable of withstanding the 2000 pound load without exceeding the ultimate tensile strength of low carbon steel, 35 ksi
  - FEA performed using ProE Mechanical



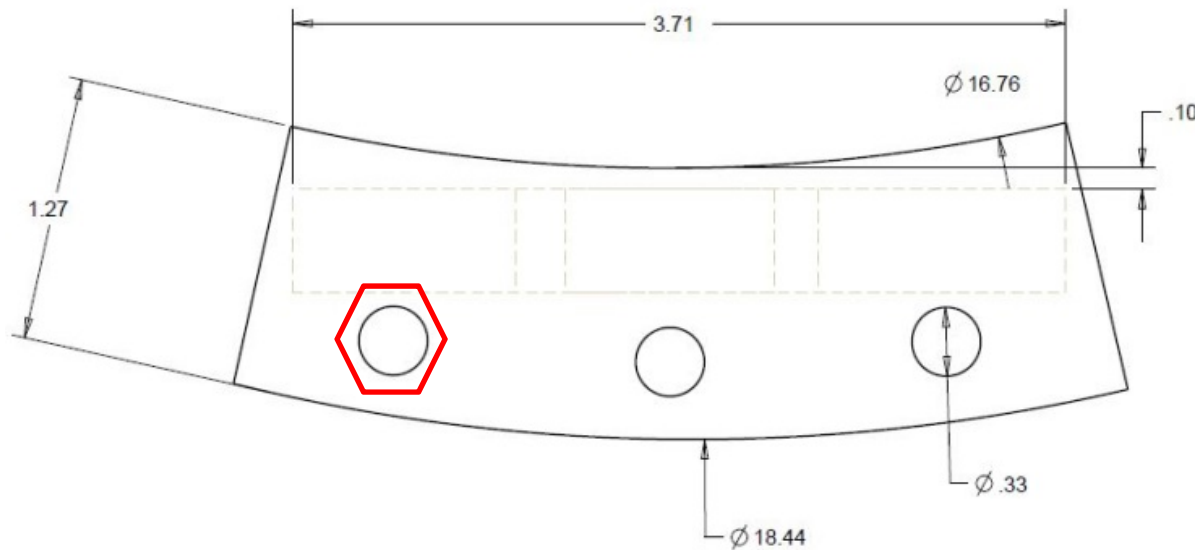
# Hoisting Fixture for Solid Rocket Motor

- Finite Element Analysis
  - 2,000 pound force acting at 45° angle
  - Low carbon steel
- Results
  - Von Mises Stress: 31.7 ksi
  - This is below the 35 ksi ultimate tensile strength for carbon steel



# Hoisting Fixture for Solid Rocket Motor

- Issues:
  - No room for bolt heads
  - Hoisting fixture was modeled based on inaccurate bolt spacing
  - Complexity of the part is unnecessary



# Rating DOT GN2 Tank for ASME



- Valve Repair shop's DOT-rated gaseous nitrogen tank in penthouse above chemistry lab
  - Current rating expires August 23, 2013
- DOT-rated tanks require hydrostatic testing every 5 years (only costs \$45!). But it costs approximately \$20,000 to remove tank to send it for testing...
- Options:
  1. Remove tank and have it DOT-recertified every 5 years
  2. Re-rate the current tank per ASME standards (desired)
  3. Do without the tank
  4. Purchase new ASME-certified tank

# Rating DOT GN2 Tank for ASME

## Option 2: Re-rate the current tank per ASME standards

- Maximum allowable working pressure calculated
  - 2195 psi
  - Does not equal or exceed the required 3000 psi

## Option 3: Do without the tank

- Valve Repair shop was going to try to go without the tank
- Testing is currently being performed to determine if valve shop can function without the tank

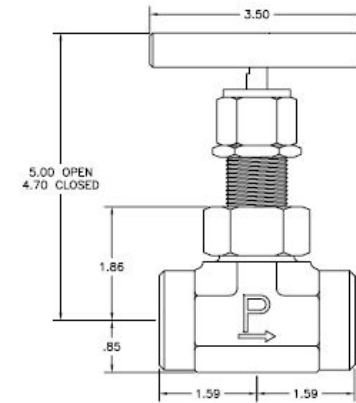
## Option 4: Purchase new ASME-certified tank

- Will not require periodic recertification
- Prentex quote for new tank was approximately \$20,000 (not including installation cost)



# Lessons Learned

- cTAPS Work
  - Applied calculations
  - Learned about hypergols and material compatibility
  - Components (ie – valves, regulators, etc.)
  - Patience with manufacturers (“customer approved” drawings)
- Designing Hoisting Fixture
  - Design process – there is always room for improvement
  - ProE Mechanical experience
- Rating GN2 Tank
  - How to rate ASME vessels
  - Familiarized with DOT and ASME requirements
- About WSTF
  - Food drives are serious business
  - Full knowledge of acronyms are necessary for survival





# The New Mexico Experience





# Future Plans

- Graduate from East Carolina University in May 2014
- Apply for NASA Co-op 😊
- Apply to graduate schools



# Acknowledgements

- Miguel Maes
- Chris Wojtko
- Bruce Havenor
- Mary Burke
- Nick Buntain
- Kathleen Franklin
- Arcenio Baca
- Christina Pina-Arpin
- John Anderson
- Don Gonzalez
- USRP

# Any Questions?



# References

- Swagelok., “60 Series Ball Valves,” [website], URL: <http://www.swagelok.com/downloads/WebCatalogs/EN/MS-01-146.pdf> [cited 13 August 2013]
- TESCO., “26-2300 Series,” [website], URL: [http://www.documentation.emersonprocess.com/groups/public/documents/data\\_sheets/d26230694x012.pdf](http://www.documentation.emersonprocess.com/groups/public/documents/data_sheets/d26230694x012.pdf) [cited 13 August 2013]